Effects of Quantum Coherence and Dynamical Fluctuations on Single Molecule RET

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Förster's resonance energy transfer (FRET) is the best-known theory of resonance energy transfer (RET), and the measurement of its efficiency has been an extremely useful tool to determine nanometer length scale distances by optical means. The utility of FRET measurement originates from its sensitivity to distance changes at about 2-10 nm due to the transition-dipole interaction mechanism. While FRET measurement is now well established and is bound to become a more powerful tool in conjunction with single molecule spectroscopy, there remain significant issues hampering its precision. From the theoretical point of view, the lack of precision of FRET measurement in complex environments is well expected considering simple assumptions and approximations underlying the theory. In recent years, significant theoretical advances were made in improving FRET by including the effects of quantum coherence and quantum dynamical modulation of electronic couplings. The present talk introduces these theories and their implications for obtaining more accurate distance information from the measurement of RET efficiency.